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TOXICITY EVALUATION OF COPPER TO THE FRESH WATER FISH, *CATLA CATLA*

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ABSTRACT
The toxicity of copper as a heavy metal was investigated to the freshwater fish *Catla catla.* It is collected from the Godavari River at Nanded. The fishes were exposed to different concentrations of Copper such as 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0 and 8.0 ppm in eight aquaria for the evaluation of toxicity of copper to the freshwater fish *Catla catla*. For the toxicity study the probit analysis method was used the percent mortality were converted to probit kill which calculated by the regration method according to the finney (1971). The value obtained for 24, 48, 72 and 96 hrs. Were 7.5, 4.8, 4.0, and 3.5 ppm respectively. The Lc 50 value was calculated as per Dragstedt and Behrens method the value is obtained for 24, 48, 72 and 96 hours were 7.38, 7.54, 4.06 and 3.95 respectively. The Lc50 values of Copper decrease with increase in exposure period with increase in duration of exposure the heavy metals become toxic even at lower concentration.

KEY WORDS: Toxicity, Copper, *Catla catla*, Godavari River.

INTRODUCTION

Copper is one of the essential trace elements occurring naturally in plant and animal tissues and its availability is influenced by physicochemical, biological factors. It makes its way into the receiving waters by extensive use in agriculture apart from usage in various industries like textile, tanneries, paints, battery, laundry, photography, copper were and piping for water distribution systems [1]. Copper ions are quite toxic to fish at various functional levels when environmental concentrations are increased [2]. Effects of the copper in fish have been studied in different fish species [3-6]. The acute toxicity is generally used to determine the concentration of a toxicant that produces a specific adverse effect on a specified percentage of test organisms in a given amount of time. Because death is normally easily detected and obviously important adverse effect, the most common acute toxicity test is acute lethality test. Experimentally effect on 50% of group of test organisms is the most reproducible and easily determined measure of toxicity and 96 hours is often a convenient and useful exposure duration. The toxicologist have demonstrated and advocated the utility of experimental toxicity testing of industrial waste and other toxicants to fish or predicting potential damage to the aquatic fauna of water bodies.

However, the selected fish for the study is a prime cultured species in India; occupy a prominent position in the aquatic system. Hence the toxicity evaluation of copper to chosen for the study.

MATERIALS AND METHODS

Preparation of stock solution of Heavy metal

A stock solution of Cooper was prepared in glass distilled water. From this stock solution different concentration were prepared as per the dilution method suggested by APHA [7].

Bioassay test for determination of LC_{50} value

Different concentrations were made from stock solution as per dilution method suggested by APHA [7]. Fresh stock solutions were used for each exposure. Static bioassay experiments were conducted as suggested by [8]. Fishes of uniform size (9 ± 2 cm) and weight (7 ± 2 gm)

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were used for all the tests. During exposure period, the animals were starved. Thirteen (08) concentrations were tried. For each concentration, 10 fishes were exposed in 50 liter test solution. This arrangement was made to maintain almost similar ratio of fish weight to water volume in the experiments. Each experiment was repeated two times. The numbers of fish killed in each concentration were recorded at regular intervals of 24, 48, 72 and 96 hours. The average mortality in each concentration was calculated and LC_{50} values for different intervals of time for Cooper was calculated by two different methods. (i) Statistical [9] (ii) Dragstedt and Behren's [10].

1. Statistical Method

This method makes use of probit analysis [9]. The percent mortality was converted into probit mortality and the values were plotted against pesticide concentration in a double logarithmic grid. To fit the straight passsing through line which is the pesticide concentration at which there was a probit kill of 50% was noted to represent LC_{50} for that exposure period**.**

2. Dragstedt – Behren's Method [10]

In this method cumulative mortality was determined at different concentrations of pesticide and percent mortalities were calculated from cumulative mortalities values. LC_{50} values were calculated by adopting the formula LC_{50} = Log A + 50 – a/ b-a × log 2

The application of the log to this formula will make the formula as follows:

Log LC_{50} = Log A + 50 – a/ b-a × log 2

Where,

A = Concentration of the pesticides having the percentage of mortality below 50%

a = Percentage of mortality below 50%.

b = Percentage of mortality immediately above 50%.

The values 'A', 'a' and 'b' were obtained after subjecting the recorded observations to cumulative mortality at 24, 48, 72 and 96 hours for Copper.

RESULTS AND DISCUSSION

In the present investigation static bioassay test was selected to see the toxicity of copper on *catla catla*. Eight different concentrations of copper 1.0 to 8.0 ppm were selected respectively. The LC_{50} values for 24, 48, 72 and 96 hours for Copper were determined by two methods.

In statistical method percent mortalities were converted to probit kills according to Finney table (1971). The value obtained for this exposure period as per probit method. The LC_{50} values obtained in this way for 24, 48, 72 and 96 hours were 7.5, 4.8, 4.0 and 3.5 ppm. The results are expressed in table no. 1, 2, 3 and 4 respectively. By following Dragsteadt and Behren's method, the LC_{50} values calculated for 24, 48, 72 and 96 hours were 7.38, 7.57, 4.06 and 3.95 ppm. The results are presented in table no. 5, 6, 7 and 8 respectively.

The average LC_{50} values for 24, 48, 72 and 96 hours were 7.44, 6.18, 4.03 and 3.72 ppm for Copper .During the period of acute toxicity tests, no mortality was observed in control group. Carpenter [11] reported the lethal action of Zinc on fish stated that coagulation anoxia in fish where a film of coagulated mucous was observed all over the body when fish were exposed to Zinc.

The film coagulated mucous was observed in fish preventing gaseous exchange at the level of gills. Senthamilselvan *et al* [1] studied on copper and lead induced histopathological alterations in gill and liver of Indian Major Carp, *Catla catla* and observed that the LC_{50} values for copper were found to be 3.5 mg/l. Similar result were found in the present investigation. Asrar Sheriff *Et.al* [13] studied on lead induced toxicity on the gills of the Indian major carp *Labeo rohita* and observed that the 96 hours LC_{50} value calculated to be 15 ppm and stated that the mortality rate showed a gradual increase with increase in the concentration of lead nitrate and hence was dose dependent. Number of authors reported that heavy metals exhibited bioaccumulation from water to fish.

They demonstrated that metal concentration in fish are higher than in water which indicates the bioaccumulation of metals in the fishes and therefore freshwater fishes can be developed as the bioindicators of metal pollution of aquatic ecosystems. Shembekar [13] studied toxicity of copper sulphate on freshwater fish *Lepiodcephalichytys thermalis* for the period of 24, 48, 72 and 96 hours and reported the Lc 50 value 3.72, 3.42, 3.08 and 1.94 ppm respectively. Abdul Naveed *et.al* [14] studied toxicity of Lithocin on the fish Channa punctatus and showed that the LC_{50} value was 19.19ppm.

Tilak *et.al* determined the lethal toxicity of phenol to the fresh water fish *Catla catla, Labeo rohita* and *Cirrhina mrigala* and observed that the 24 hours LC_{50} values were found to be 25.84, 30.32 and 34.97 mg/l. Bakshi [15], Burton *et.al* [16] he stated that any heavy metal is toxic to aquatic animal and mortality will be occurred. K. Muthukumaravel and P. Rajaraman [17] studied on the toxicity of chromium on the histology of gill and liver of freshwater fish Labeo rohita and observed that the fingerling were exposed for 10, 20 and 30 days in 10% sublethal concentration of 96 hours of chromium were 3.5 ppm. J. Selvanathan *et.al* [18] studied on histopathological changes in freshwater fish *Clarias batrachus* exposed to mercury and cadmium and reported that the Lc 50 value of Mercury 0.19, 0.09, 0.05 and 0.03 ppm and chloride 0.66, 0.30,0.17 and 0.12 ppm for 30 days. Similar observations were made by the Agrawal [19], nickel toxicity, Chaudhary [20], Nickel toxicity and Kaur and Kaur [21] studied on Nickel and chromium.

Table 1. Mortality of fish *Catla catla* at different concentration of copper for 24 hours exposure period (Each value represents an average of 5 replicants)

Sr. No.	Conc. (in ppm)	Log conc.	Fish exposed	Fish Dead	Percent kill	Probit kill
1	3.0	0.4771	10	01	10	3.72
2	4.0	0.6021	10	02	20	4.16
3	5.0	0.6990	10	06	60	5.25
4	6.0	0.7782	10	07	70	5.84
5	7.0	0.8451	10	09	90	6.28
6	8.0	0.9031	10	10	100	7.33

Table 2. Mortality of fish *Catla catla* at different concentration of copper for 48 hours exposure period (Each value represents an average of 5 replicants)

Sr. No.	Conc. (in ppm)	Log conc.	Fish exposed	Fish Dead	Percent kill	Probit kill
1	5.0	0.6990	10	01	10	3.72
2	6.0	0.7782	10	03	30	4.48
3	7.0	0.8451	10	06	60	5.25
4	8.0	0.9031	10	10	100	7.33

Table 3. Mortality of fish *Catla catla* at different concentration of copper for 72 hours exposure period (Each value represents an average of 5 replicants)

Sr. No.	Conc. (in ppm)	Log conc.	Fish exposed	Fish Dead	Percent kill	Probit kill
1	2.0	0.3010	10	01	10	3.72
2	3.0	0.4771	10	03	30	4.48
3	4.0	0.6021	10	06	60	5.25
4	5.0	0.6990	10	08	80	5.84
5	6.0	0.7782	10	09	90	6.28
6	7.0	0.8451	10	10	100	7.33

Table 4. Mortality of fish *Catla catla* at different concentration of copper for 96 hours exposure period (Each value represents an average of 5 replicants)

Sr. No.	Conc. (in ppm)	Log conc.	Fish exposed	Fish Dead	Percent kill	Probit kill
1	2.0	0.3010	100	01	10	3.72
2	3.0	0.4771	10	04	40	4.75
3	4.0	0.6021	10	07	70	5.52
4	5.0	0.6990	10	09	90	6.28
5	6.0	0.7782	10	10	100	7.33

Table 5. Cumulative and absolute mortality of *Catla catla* exposed to copper at 24 hours.

Sr. No.	Conc.	Absolute			Cumulative		
	(in ppm)	Live	Dead	%	Live	Dead	%
1	1.0	10	00	00	60	00	00
2	2.0	10	00	00	50	00	00
3	3.0	10	00	00	40	00	00
4	4.0	10	00	00	30	00	00
5	5.0	09	01	10	20	01	5.0
6	6.0	07	03	30	11	04	28.57
7	7.0	04	06	60	04	10	71.42
8	8.0	00	10	100	00	20	100

Log LC50 = log A + 50 – a/ b-a × log 2

= log 6.0 + 50 – 28.57/ 71.42-28.57 × 0.3010

= 0.8685, Antilog of 0.9072 = 7.387

Table 6. Cumulative and absolute mortality of *Catla catla* exposed to copper at 48 hours

Sr. No.	Conc. in ppm	Absolute			Cumulative		
		Live	Dead	%	Live	Dead	%
1	1.0	10	00	00	45	00	00
2	2.0	10	00	00	35	00	00
3	3.0	09	01	10	25	01	3.84
4	4.0	08	02	20	16	03	15.78
5	5.0	04	06	60	08	09	52.94
6	6.0	03	07	70	04	16	80.00
7	7.0	01	09	90	01	25	96.15
8	8.0	00	10	100	00	35	100

Log LC50 = log A + 50 – a/ b-a × log 2
= log 4.0 + 50 – 15.78/ 52.94-15.78 × 0.3010
= 0.8792, Antilog of 0.8792 = 7.571

Table 7. Cumulative and absolute mortality of *Catla catla* exposed to copper at 72 hours.

Sr. No.	Conc. in ppm	Absolute			Cumulative		
		Live	Dead	%	Live	Dead	%
1	1.0	10	00	0	33	0	00
2	2.0	09	01	10	23	1	4.16
3	3.0	07	03	30	14	4	22.22
4	4.0	04	06	60	07	10	58.82
5	5.0	02	08	80	03	18	85.71
6	6.0	01	09	90	01	27	96.42
7	7.0	00	10	100	00	37	100

Log LC50 = log A + 50 – a/ b-a × log 2
= log 3.0 + 50 – 22.22/ 85.71-22.22 × 0.3010
= 0.608, Antilog of 0.6088 = 4.062

Table 8. Cumulative and absolute mortality of *Catla catla* exposed to copper at 96 hours

Sr. No.	Conc. in ppm	Absolute			Cumulative		
		Live	Dead	%	Live	Dead	%
1	1.0	10	00	0	29	0	00
2	2.0	09	01	10	19	01	5.0
3	3.0	06	04	40	10	05	33.33
4	4.0	03	07	70	04	12	75.00
5	5.0	01	09	90	01	21	95.45
6	6.0	00	10	100	00	31	100

Log LC50 = log A + 50 – a/ b-a × log 2
= log 3.0 + 50 – 33.33/ 75.00-33.33 × 0.3010
= 0.5975, Antilog of 0.5975 = 3.959

CONCLUSION

In the present investigation the toxicity of Copper to the freshwater fish *Catla catla* was determined by conducting toxicity test. The LC_{50} values of copper were determined by the three methods Probit analysis and Dragstead and Behrens method. The average value was found 3.7 ppm. The above results were cleared that LC_{50} values decreased with increased in exposure period with increase in duration of exposure the heavy metals become toxic even at lower concentration.

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